IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Nayfeh et al.

Serial No. (Not Assigned) Group Art Unit: (Not Assigned)

Filed (concurrently herewith) Examiner (Not Assigned)

This application is a continuation application of

Nayfey et al.

Serial No.: 09/702,857 Group Art Unit: 2121

Filed: November 1, 2000 Examiner: Pham, Thomas K.

For: NONLINEAR ACTIVE CONTROL OF DYNAMICAL SYSTEMS

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REQUEST FOR AN INTERFERENCE WITH A PATENT UNDER 37 C.F.R. 1.607

Sir:

Concurrently filed herewith is a continuation application of U.S. Serial No. 09/702,857 together with a preliminary amendment adding claims.

The undersigned proposes an interference between the continuation application and U.S. Patent 6,496,765.

The proposed count is claim 4 of U.S. Patent 6,496,765 which reads as follows:

Count 1. A control system for generating crane commands from a desired payload motion for substantially pendulation-free actual payload motion, wherein the crane is mounted with a base platform characterized by a changeable configuration, wherein the crane comprises a manipulator, a flexible-link attached to the manipulator, and a payload suspended from the flexible-link wherein the control system comprises:

a) a platform motion sensor, indicative of a motion of the base platform relative to an inertial frame; and

b) a motion compensator, responsive to the platform motion sensor, generating crane commands to maintain the payload substantially in a defined payload configuration.

The proposed count corresponds to claim 31 added by amendment to the present continuation application. While it is not an exact duplicate of the claim, it is clear that the manipulator corresponds to the boom, and the flexible link corresponds to the hoisting line.

Support for the count can be found in the application with the following annotated version of new claims 30-37:

30. A control system to significantly reduce in-plane and out-of-plane payload pendulations (line 17 page 3, line 5 page 16) on platform-mounted cranes executing desired maneuvers, wherein the pendulations are induced by the operator input, the platform motion, and external disturbances (line 24 page 6), wherein the crane is mounted on a moving platform (referenced many times, example line 15 page 4, line 7 page 6; line 16 page 23; 10 Figure 1), wherein the crane comprises a boom having a boom tip (referenced many times, example line 28 page 3, line 5 page 7), a hoisting cable (referenced many times, example line 19 page 4 and line 24 page 3) attached to the boom tip, and a payload (referenced many times, example line 9 page 10) suspended from the hoisting cable, wherein the crane system comprises:

a) a set of motion sensors, indicative of the platform relative to an inertial frame; (line 19 page 4, line 19 page 6, line 23 page 7, line 10 page 16, line 14 page 21, line 19 page 21; Ship motion sensors 318 in Figure 3; line 15 page 9; tilt sensor 62 in Figure 13 and line 19 page 21.)

b) a motion compensator, responsive to the platform motion, generating commands to isolate the payload from the platform motion (line 28 page 3 to line 2 page 4, line 10 page 4 to line 13 page 4, line 18 page 17) and maintain the payload in a defined configuration relative to the inertial frame (line 2 page 17, line 1 page 8, line 31 page 8 line 3 page 12, line 3 page 18); (The motion compensator algorithm is described in detail staring line 21 on page 16 till line 17 page 17, including Equations (22)-(26); and Reference luff & slew angles calculator 320, Boom slew tracking calculator 324, and Boom luff tracking calculator 328 in Figure 7; 320, 324, 328, 330, and 332 in Figure 13).

c) a set of payload sensors, indicative of the current payload configuration; (line 17 page 6, encoder 24 line 11 page 7, line 8 page 8, line 9 page 16, a set of encoders or tilt sensors 28 lines 14& 15 page 7; and sensors 306a & 306b, sensor 322, sensor 326 in Figure 3, 60 in Figure 13.; optical encoders 60 line 20 page 21 and Figure 13) and

d) a time-delayed feedback control algorithm to damp payload pendulations. (line 22 page 6, line 25 page 7, All of page 12, starting line 17 page 17 till line 17 page 18; 308a, 308b, 310a, 310b, 312a, 312b, and 314 in Figure 3.)

31. A control system to significantly reduce in-plane and out-of-plane payload pendulations (line 17 page 3, line 5 page 16) on platform-mounted cranes executing desired maneuvers, wherein the pendulations are induced by the operator input, the platform motion, and external disturbances (line 24 page 6), wherein the crane is mounted on a moving platform (referenced many times, example line 15 page 4, line 7 page 6; line 16 page 23; 10 Figure 1), wherein the crane comprises a boom having a boom tip (referenced many times, example line 28 page 3, line 5 page 7), a hoisting cable (referenced many times, example line 19 page 4 and line 24 page 3) attached to the boom tip, and a payload (referenced many times, example line 9 page 10) suspended from the hoisting cable, wherein the crane system comprises:

e) a set of platform sensors, indicative of the platform motion relative to an inertial frame(line 19 page 4, line 19 page 6, line 23 page 7, line 10 page 16, line 14 page 21, line 19 page 21; Ship motion sensors 318 in Figure 3; line 15 page 9; tilt sensor 62 in Figure 13 and line 19 page 21.) and

f) a motion compensator, responsive to the platform motion, generating commands to maintain the payload in a defined configuration relative to the inertial frame. ; (line 2 page 17, line 1 page 8, line 31 page 8 line 3 page 12, line 3 page 18); (The motion compensator algorithm is described in detail staring line 21 on page 16 till line 17 page 17, including Equations (22)-(26); and Reference luff & slew angles calculator 320, Boom slew tracking calculator 324, and Boom luff tracking calculator 328 in Figure 7; 320, 324, 328, 330, and 332 in Figure 13).

32. The control system of claim 31,

g) wherein the motion compensator is adapted to maintain the payload in the defined payload configuration relative to the inertial frame; (line 2 page 17, line 1 page 8, line 31 page 8 line 3 page 12, line 3 page 18); (The motion compensator algorithm is described in detail staring line 21 on page 16 till line 17 page 17, including Equations (22)-(26); and Reference luff & slew angles calculator 320, Boom slew tracking calculator 324, and Boom luff tracking calculator 328 in Figure 7; 320, 324, 328, 330, and 332 in Figure 13) and

h) wherein the motion compensator comprises an inverse kinematics solver to determine a manipulator configuration to drive the payload to the desired configuration with significantly reduced pendulations (A description of the inverse kinematics is described in detail starting line 9 page 17 till line 18 page 18; Reference luff& slew angles calculator 320, boom slew tracking controller 324, and boom luff tracking controller 328 in Figure 3)

33. The control system of claim 30, wherein an example of the motion compensator comprises:
   i) transforming the positions of the boom tip and hence the payload from the platform-fixed coordinate system (x", y", z"), Fig 7, into the coordinates x_p and y_p in the inertial coordinate system (x, y, z) using:
      i) a series of roll φ_{roll} and pitch φ_{pitch} rotations matrices; and
      ii) a vector describing the ship sway w, surge u, and heave h motions, Eq. 22 and Fig 7;
   j) converting the operator commanded luff β_i and slew α_i angles into the desired x_i and y_i coordinates in the inertial frame using Eqs. 25 and 26;
   k) replacing x_p and y_p with x_i and y_i in the transformation, Eq. 22; and
   l) using inverse kinematics to solve for the required the luff and slew angles to maintain the boom tip stationary in the inertial frame.

34. A control system to significantly reduce in-plane and out-of-plane payload pendulations (line 17 page 3, line 5 page 16) on platform-mounted cranes executing desired maneuvers, wherein the pendulations are induced by the operator input, the platform motion, and external disturbances (line 24 page 6), wherein the crane is mounted on a moving platform (referenced many times, example line 15 page 4, line 7 page 6; line 16 page 23; 10 Figure 1), wherein the crane comprises a boom having a boom tip (referenced many times, example line 28 page 3, line 5 page 7), a hoisting cable (referenced many times, example line 19 page 4 and line 24 page 3) attached to the boom tip, and a payload (referenced many times, example line 9 page 10) suspended from the hoisting cable, wherein the crane system comprises:
   m) a sensor system, comprising:
      i) a platform sensor subsystem, indicative of the platform motion relative to an inertial frame; (line 19 page 4, line 19 page 6, line 23 page 7, line 10 page 16, line 14 page 21, line 19 page 21; Ship motion sensors 318 in Figure 3; line 15 page 9; tilt sensor 62 in Figure 13 and line 19 page 21.)and
      ii) a payload sensor subsystem, indicative of the current configuration of the payload; (line 17 page 6, encoder 24 line 11 page 7, line 8 page 8, line 9 page 16, a set of encoders or tilt sensors 28 lines 14& 15 page 7; and sensors 306a & 306b, sensor 322, sensor 326 in Figure 3, 60 in Figure 13.; optical encoders 60 line 20 page 21 and Figure 13) and
   n) a control computer (line 11page 16, line 28 page 21), generating commands to drive crane actuators payload to the desired configuration in response to the sensor system, wherein the control computer is adapted to maintain the payload in the desired configuration relative to the inertial frame with significantly reduced pendulations, the control computer comprising:

i) a motion compensator, responsive to the platform motion sensors and the desired payload configuration, generating commands to maintain the payload in the desired configuration relative to the inertial frame; (line 2 page 17, line 1 page 8, line 31 page 8 line 3 page 12, line 3 page 18); (The motion compensator algorithm is described in detail staring line 21 on page 16 till line 17 page 17, including Equations (22)-(26); and Reference luff & slew angles calculator 320, Boom slew tracking calculator 324, and Boom luff tracking calculator 328 in Figure 7; 320, 324, 328, 330, and 332 in Figure 13).and
ii) a time-delayed algorithm to generate delayed-position feedback correction that produces damping of the payload pendulations. (line 22 page 6, line 25 page 7, All of page 12, starting line 17 page 17 till line 17 page 18; 308a, 308b, 310a, 310b, 312a, 312b, and 314 in Figure 3.)

35. A control system to significantly reduce in-plane and out-of plane payload pendulations (line 17 page 3, line 5 page 16) on platform-mounted cranes executing desired maneuvers, wherein the pendulations are induced by the operator input, the platform motion, and external disturbances (line 24 page 6), wherein the crane is mounted on a moving platform (referenced many times, example line 15 page 4, line 7 page 6; line 16 page 23; 10 Figure 1), wherein the crane comprises a boom having a boom tip (referenced many times, example line 28 page 3, line 5 page 7), a hoisting cable (referenced many times, example line 19 page 4 and line 24 page 3) attached to the boom tip, and a payload (referenced many times, example line 9 page 10) suspended from the hoisting cable, wherein the crane system comprises:

o) determining the platform configuration, indicative of the motion of the platform relative to an inertial frame; (line 19 page 4, line 19 page 6, line 23 page 7, line 10 page 16, line 14 page 21, line 19 page 21; Ship motion sensors 318 in Figure 3; line 15 page 9; tilt sensor 62 in Figure 13 and line 19 page 21.)
p) determining the current configuration of the payload; ; (line 17 page 6, encoder 24 line 11 page 7, line 8 page 8, line 9 page 16, a set of encoders or tilt sensors 28 lines 14& 15 page 7; and sensors 306a & 306b, sensor 322, sensor 326 in Figure 3, 60 in Figure 13.; optical encoders 60 line 20 page 21 and Figure 13)
q) generating compensated command to maintain the payload in the desired payload configuration relative to the inertial frame, responsive to the platform motion and the desired payload configuration; (line 2 page 17, line 1 page 8, line 31 page 8 line 3 page 12, line 3 page 18); (The motion compensator algorithm is described in detail staring line 21 on page 16 till line 17 page 17, including Equations (22)-(26); and Reference luff & slew angles calculator 320, Boom slew tracking calculator 324, and Boom luff tracking calculator 328 in Figure 7; 320, 324, 328, 330, and 332 in Figure 13).

r) generating delayed-position feedback correction that produces damping of the payload pendulations; (line 22 page 6, line 25 page 7, All of page 12, starting line 17 page 17 till line 17 page 18; 308a, 308b, 310a, 310b, 312a, 312b, and 314 in Figure 3.) and

s) generating crane commands from compensated commands and delayed-position signals.(Reference luff & slew angles calculator 320, Boom slew tracking calculator 324, and Boom luff tracking calculator 328 in Figure 7; 320, 324, 328, 330, and 332 in Figure 13).

36. The control system of claim 30, wherein the suspension point of the payload hoist line can be moved using:

t) a boom tip in rotary boom cranes; (line 20 page 3)

u) a trolley in gantry and quayside container cranes; (line 20 page 3, line 12 page 6) and

v) a trolley sliding on a rotating jip in rotary jip cranes. (line 11 page 9 to line 13 page 9)

37. The control system of claim 30,

w) wherein crane includes land-based rotary boom cranes, rotary jip cranes, gantry cranes, and quayside container cranes; (line 20 page 3, line 17 page 23) and

x) wherein for land-based cranes, the motion of the moving platform is set equal to zero (stationary platform).(Equations 22)-(26)

If any fees are due to grant this request for an interference, the Examiner is authorized to charge attorney's deposit account 50-2041 (Whitham, Curtis & Christofferson, P.C.).

Respectfully submitted,

Olga V. Merkoulova
Reg. No. 48,757

WHITHAM CURTIS &
CHRISTOFFERSON, P.C.
11491 Sunset Hills Rd., Suite 340
Reston, VA 20190
Tel. 703-787-9400
Customer No.: 30743